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Software-Intensive Weapons

Assessing Software Risk

Multi-Dimensional Assessment of Technology Maturity Workshop
Fairborn, Ohio
May 11, 2006

Report Documentation Page

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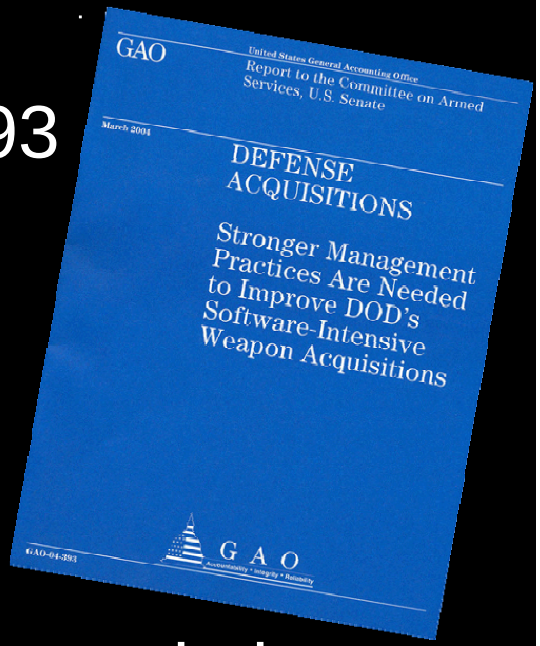
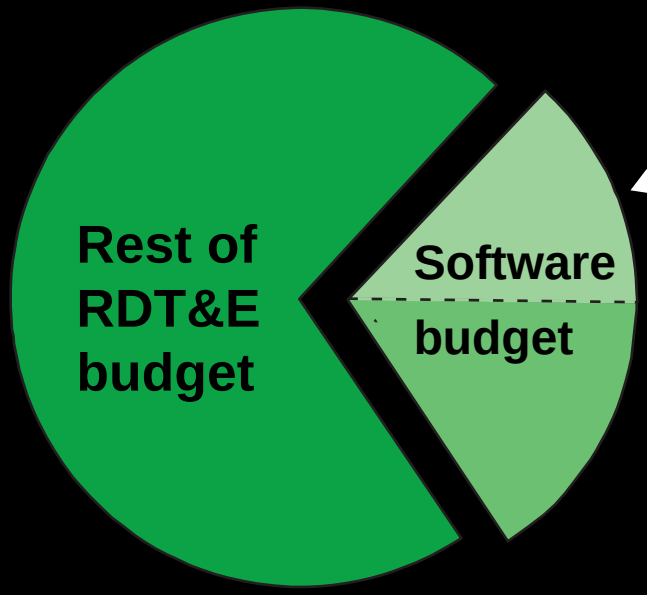
Briefing Outline

- Overview of GAO-04-393
- Background
- Objective, scope, and methodology
- Audit findings
- Conclusions and recommendations



DOD Funding

- DOD estimates that 40% of the RDT&E budget is spent on software
  (about $30 billion in FY 06)



As much as 40% of software budget is spent on rework
(about $12 B in FY 06)

Objectives

- Identify best practices and metrics
- Analyze causes of poor outcomes

Scope and Methodology

DOD cases

- F/A 18 C/D fighter attack aircraft
- Tactical Tomahawk missile
- F/A-22 air superiority and ground attack aircraft
- Space-Based Infrared System, a missile-detection satellite system
- Comanche, a multi-mission helicopter

Commercial cases

- Motorola
- NCR Teradata
- General Motors
- Computer Sciences Corp.

F-22 Experience

Initially put together a sound strategy for software development. However…….

- Significant requirements volatility

  - RDT&E estimate grew 127%
  - Cycle time grew 104%

Comanche Experience

- Inadequate Requirements Analysis
- Requirements Volatility

- 231% increase in RDT&E cost estimate
- 120% change in cycle time

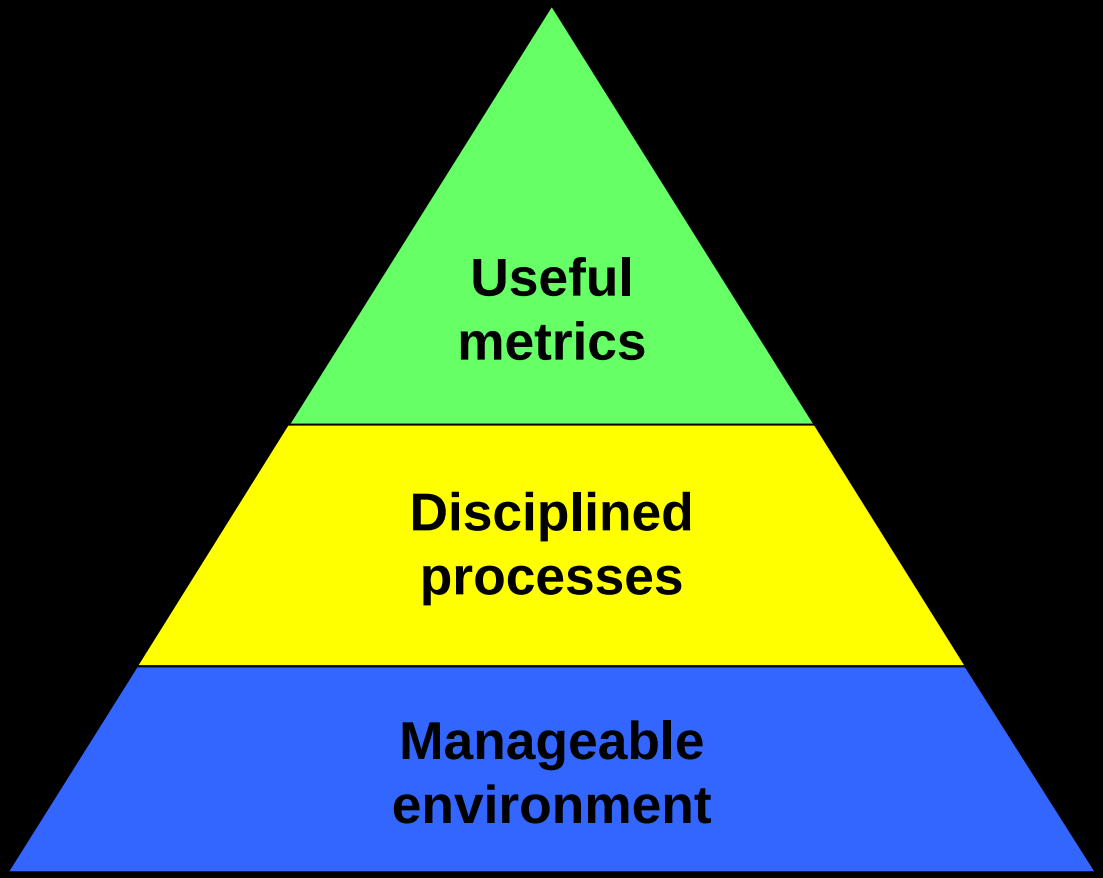
CANCELLED

SBIRS Experience

- Uncontrolled Requirements Growth
- Optimistic Reuse Expectations
- Systems Engineering Deficiencies

113% Increase in RDT&E Costs

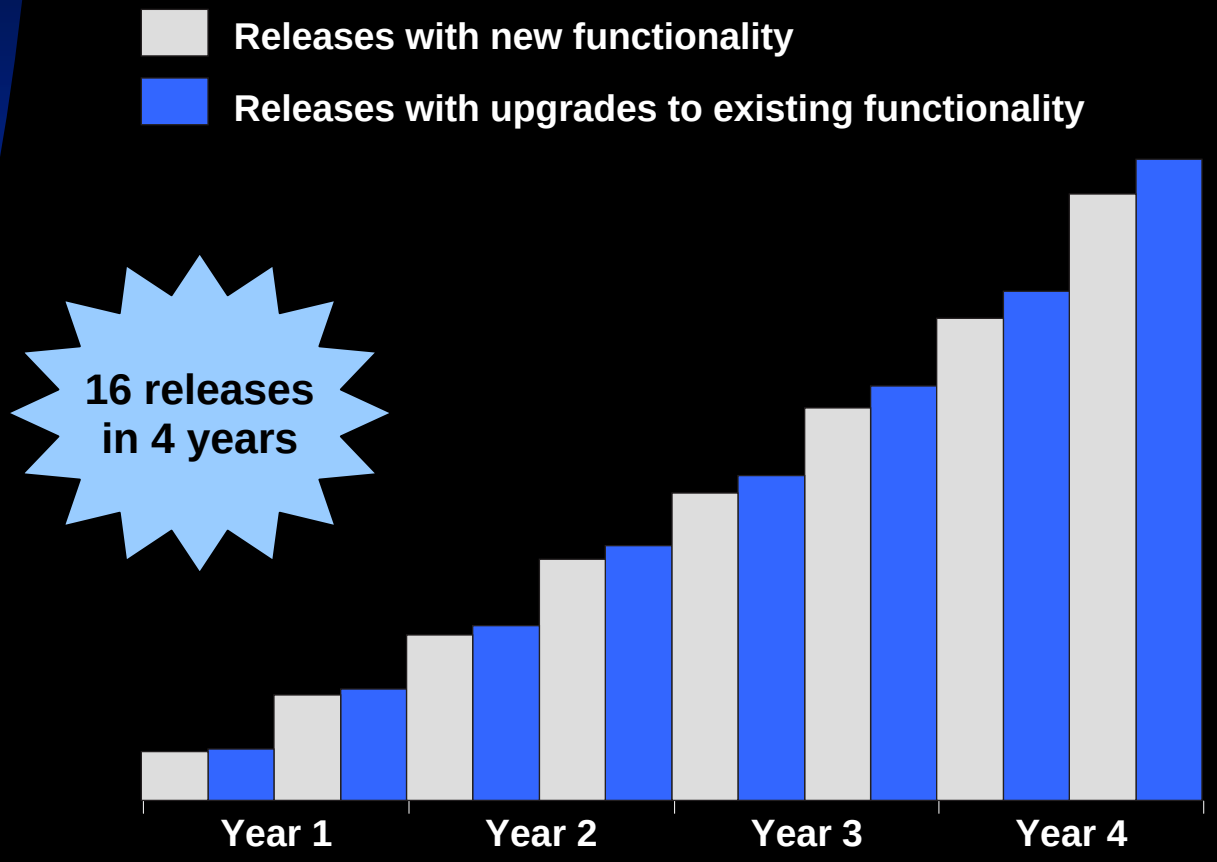
Factors Contributing to Successful Outcomes



Audit Findings

Factors Contributing to Successful Outcomes

General Motors' Development Approach: Growing Capability Over Time

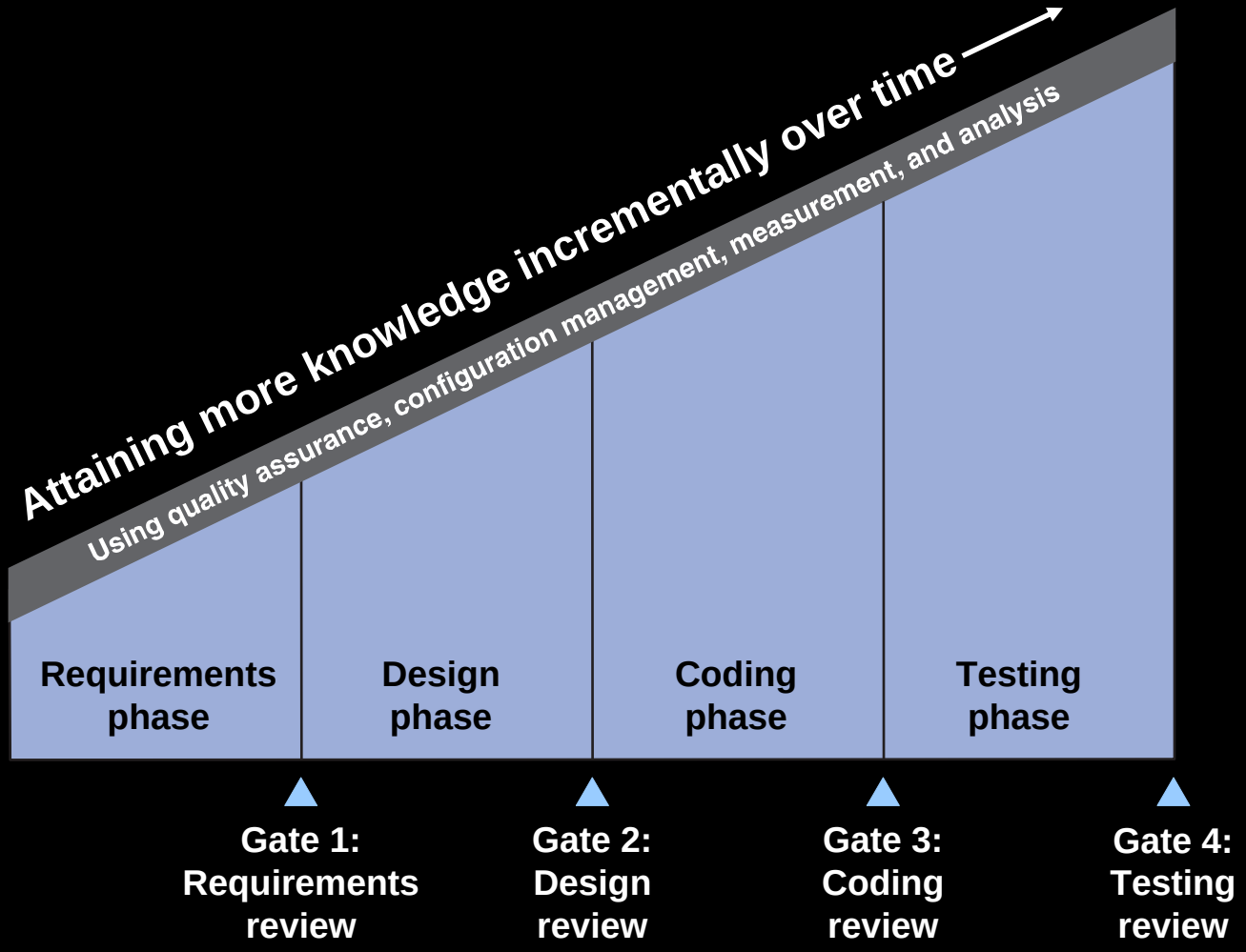


Structured, Gated Reviews

Audit Findings

Factors Contributing to Successful Outcomes

Disciplined Processes

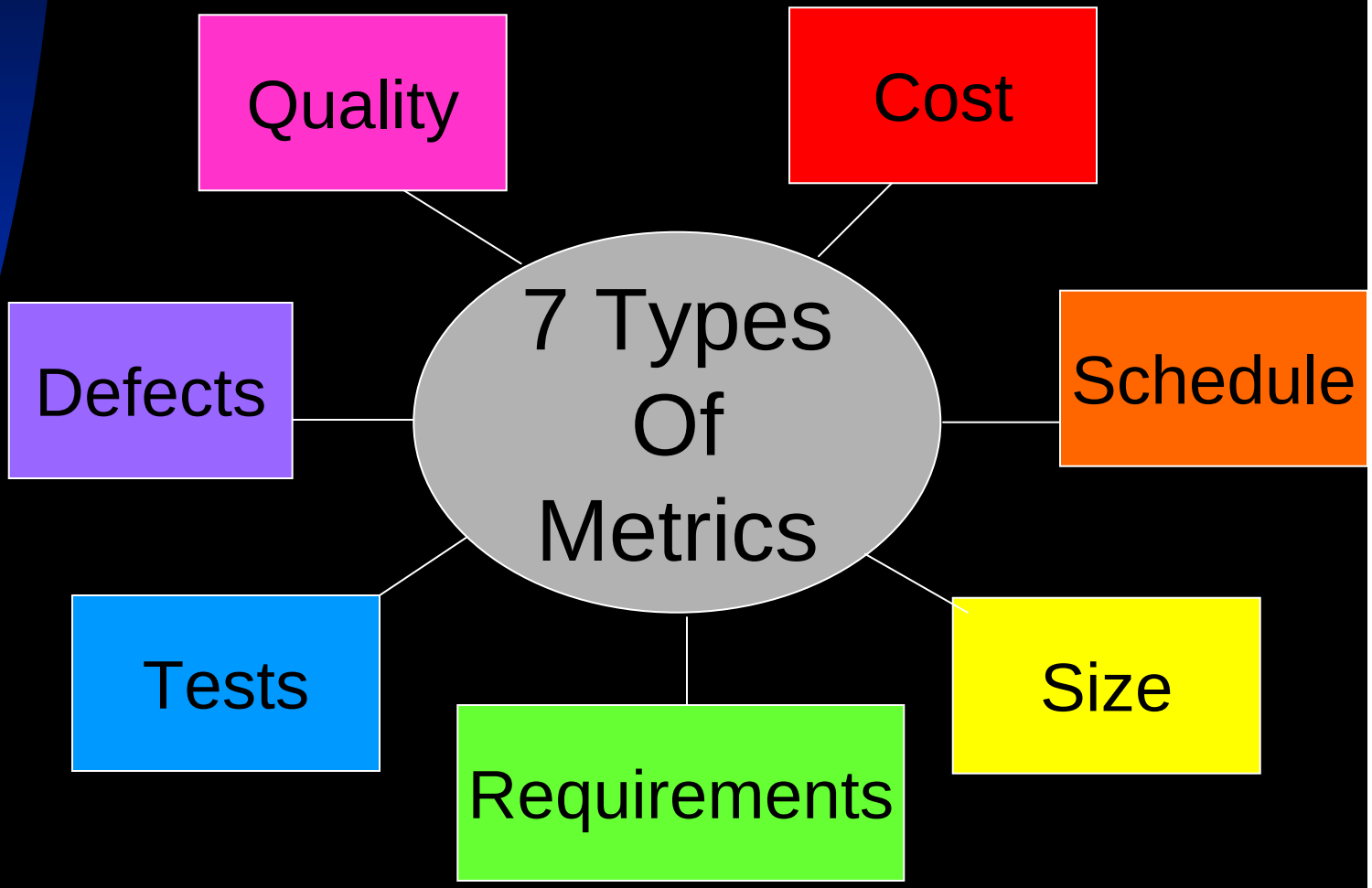


Good developers don't just wait for the four gated reviews to come along; they proactively review software development on a weekly basis

Audit Findings

Factors Contributing to Successful Outcomes

Metrics



Audit Findings

Factors Contributing to Successful Outcomes

F-18 C/D	F-22
Schedule	Schedule
Requirements	Requirements
Size	Size
Design	Design
Cost	Cost
Quality	Quality
Test	Test
36% RDT&E Cost Growth 6% Schedule Growth	127% RDT&E Cost Growth 104% Schedule Growth

Audit Findings

Factors Contributing to Successful Outcomes

DOD Program Outcomes Linked to Management Controls

Program	Evolutionary environment	Disciplined process	Useful metrics	% change in research, development, test, and evaluation cost estimate	% change in cycle time estimate
Tomahawk	Yes	Yes	Yes	7.6	22.4
F/A-18 C/D	Yes	Yes	Yes	36.4	6.2
F/A-22*	No	No	No	127	104
SBIRS*	No	No	No	113	Not available
Comanche*	No	No	No	231	120

* GAO's assessment addresses conditions found before these programs were restructured

Conclusions

- Software-intensive weapon programs are more likely to reach successful outcomes if they used evolutionary environments and disciplined process and managed by metrics. Programs that did not employ these practices consistently garnered poor results from software acquisition.

Recommendations

- Develop a list of systems engineering deliverables
- Set requirements based on systems engineering
- Require contractors to report on seven types of metrics
- Include and enforce practices in policies, improvement plans, and development contracts

DOD Response

- Air Force adopted recommendations
- 5000 Series Acquisition Policy was amended to include more emphasis on systems engineering and evolutionary development